



## Monte Carlo modelling of the protons and hydrogen atoms transport in the Martian upper atmosphere

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We used the Direct Simulation Monte Carlo (DSMC) method to solve the kinetic equation with magnetic field for H/H<sup>+</sup> transport in the upper atmosphere of Mars. We used solar minimum atmosphere from Bouger et al., (1990, 1999, 2000; also personal communication, 2007), latest available cross sections, magnetic field from the MGS measurements, and precipitating spectrum of protons at 500 km from the Mars Express ASPERA-3 measurements in the energy range 300 eV – 20 keV. In the no magnetic field case around 12% of the precipitating protons are reflected upward from the exobase while including a 20 nT field in the altitude range the exobase (250 km) – 500 km results in 40% - 50% reflection depending on the precipitating velocity distribution. Around 40% of the downgoing flux measured at 500 km by Mars Express is reflected upwards. The main conclusion of the modelling is the magnetic field plays the critical role for the particle transport and thus the energy and matter deposition from the solar wind into the upper atmosphere of Mars.